Application for:

Revised Locally Adopted Energy Standards by the City of Mill Valley for Houses Larger than 3,500 Square Feet In Accordance With Section 10-106 of the California Code of Regulations, Title 24, Part 1

December 30, 2005

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Executive Summary

The City of Mill Valley has researched and reviewed the County of Marin's *Single Family Dwelling Energy Efficiency Ordinance* (the "Ordinance") which was designed to reduce the annual energy consumption and peak electricity and natural gas loads of large homes. In the Marin County Ordinance approved by the California Energy Commission, any single family residential building larger than 3,500 square feet cannot exceed the Title 24 energy use of the equivalent 3,500 square foot home.

On December 5, 2005, the Mill Valley City Council approved the adoption of the same language as local Ordinance No. 1213. The intent is for the City of Mill Valley to implement their Ordinance at the earliest convenient date following the requisite approval by the California Energy Commission.

The City of Mill Valley has retained Gabel Associates, LLC to make the necessary minor, non-substantive revisions to the current Marin County ordinance and assist the City in this application to the Commission. As stated in the County of Marin ordinance application, the proposed local energy ordinance and implementation have been designed with several key criteria in mind. These include:

- Consistency with the structure, format and calculation methods of the 2005 Title 24 Building Energy Efficiency Standards;

- Meeting the intent of the proposed Ordinance by demonstrating that the level of energy consumption of homes larger than 3,500 sf use no more total TDV energy than the equivalent 3,500 sf house;

- Simplicity and clarity for building department enforcement for both energy plan review and field inspection; and,

- The provision of maximum flexibility for building permit applicants in meeting the Ordinance by one or more design approaches: (a) energy conservation measures; (b) glazing area and glazing orientation; (c) installation of a solar photovoltaic (PV) system or other alternative energy systems; and/or (d) reduction of total conditioned floor area.

This Application to the California Energy Commission follows the requirements laid out in Section 10-106 of the California Code of Regulations, Title 24, Part 1, *LOCALLY ADOPTED ENERGY STANDARDS*. The proposed Ordinance takes effect only after the Commission has reviewed and formally approved the proposed local energy standards in meeting all requirements of Section 10-106.

Statement per Section 10-106(b)3. The proposed Ordinance will require that all residential buildings are designed to consume no more TDV energy than permitted by Title 24, Part 6. Under the proposed ordinance*, residential single-family buildings over 3,500 square feet of total conditioned area will consume less energy than the 2005 Building Energy Efficiency Standards require.*

For any detailed questions concerning the development methodology or the descriptions outlined in this application, please contact Michael Gabel at Gabel Associates, LLC.

Development of the New Ordinance

Prototype House. For the purpose of this study, a prototype house was developed with a total conditioned floor area of 3,500 sf. The Prototype House establishes the geometry of a typical large custom house design, without specifying the energy conservation measures or levels of energy components such as fenestration, insulation or HVAC and domestic hot water system efficiencies.

The Prototype House is a 2-story structure, with a raised floor over a crawl space, and 9' ceilings w/ attic space. Exactly 60% of the total area is on the 1st floor, and 40% is on the 2nd floor. The aspect ratio (length to width) is 2:1 on 1st floor, and 3:2 on 2nd floor. There is 22.0% glazing as vertical sliding windows (7.7% on front & rear elevations, 3.3% on left & right elevations); and 0.5% as horizontal skylight for a grand total of 22.5% glazing. Space heating is provided by two forced air furnaces, one serving the upstairs and one the downstairs; and no air conditioning is installed. Ducts are in the crawl space for the 1st floor, and in the attic for the 2nd floor. A large (75 gal) storage tank water heater serves the whole house. The prototype house description is based on 20 years experience by Gabel Associates in assisting architects, homeowners and builders meet the energy code for large custom homes within the Mill Valley area.

The same prototype house, with the same relative 1st and 2nd floor areas and aspect ratios has also been developed for 4,000 sf; 5,000 sf; 6,000 sf; 7,000 sf; 8,000 sf; 9,000 sf; 10,000 sf; 11,000 sf and 12,000 sf homes. Each of the prototype houses has been analyzed with the most current state-certified version of EnergyPro v4.0 to establish what the energy budget is for each of these size homes under the 2005 Building Energy Efficiency Standards in Climate Zone 3. Climate Zone 3 represents all locations within the City of Mill Valley. The results are listed in Table 1.

Table 1. Energy Budgets for the Prototype House under the 2005 Energy Standards.

House Size (Square Feet)	Climate Zone 3 Title 24 Budget (TDV KBtu/sf-yr)
3,500	24.68
4,000	23.23
5,000	20.33
6,000	19.68
7,000	18.60
8,000	17.78
9,000	17.12
10,000	16.57
11,000	16.11
12,000	15.72

Energy Budgets Under the New Ordinance. Applying the requirements of the proposed Ordinance, a house over 3,500 sf shall use no more energy than the equivalent house with 3,500 sf of conditioned space. Table 2 summarizes the theoretical energy budgets for the prototype house (which is the middle value of each category or range of House Size listed under Mill Valley's proposed Ordinance).

Table 2. Energy Budgets for the Prototype House under the Mill Valley Ordinance

House Size (Square Feet)	Climate Zone 3 Title 24 Budget (TDV KBtu/sf-yr)
3,500	24.68
4,000	21.60
5,000	17.28
6,000	14.40
7,000	12.34
8,000	10.80
9,000	9.60
10,000	8.64
11,000	7.85
12,000	7.20

For the purposes of implementation, houses are grouped according to total conditioned floor area. Houses with between 3,501 sf and 4,499 sf exceed the energy performance of Title 24 based on a 4,000 sf house; houses with between 4,500 sf and 5,499 sf are based on the requirements for a 5,000 sf house; and so on (as illustrated in Table 3). A house size of 12,000 sf represents all houses greater than 11,500 sf.

Table 3 uses the implementation tiers or categories of the Ordinance to establish what the revised energy budget for the prototype house would be in Climate Zone 3, and the percentage (%) by which the house submitted for permit must exceed the Title 24 budget listed in Table 1.

Table 3. Climate Zone 3 Energy Budgets under the Proposed Ordinance for Various House Sizes and the Relationship to the 2005 Title 24 Energy Budget

House Size (Square Feet)	Proposed Ordinance Energy Budget (TDV KBtu/sf-yr)	Must Exceed Title 24 Budget By (%)
3,500 – 4,499	21.60	7.0%
4,500 – 5,499	17.28	15.0%
5,500 – 6,499	14.40	26.8%
6,500 – 7,499	12.34	33.7%
7,500 – 8,499	10.80	39.3%
8,500 – 9,499	9.60	43.9%
9,500 – 10,499	8.64	47.9%
10,500 – 11,499	7.85	51.3%
11,500+	7.20	54.2%

Incremental Energy Measures

To determine how real-world house designs fare within the framework of the proposed Ordinance, many incremental energy measures were evaluated. Because houses in Mill Valley are generally assumed to have no air conditioning, energy measures specific to cooling efficiency (e.g., high EER, TXV, adequate air flow, maximum cooling efficiency) were not used in this study. All other energy efficiency measures are considered to be practical and cost-effective in a large single family home with heating only. The measures and associated modeling assumptions include the following:

- R-21 insulation in all exterior walls; R-30 in raised floors over crawl space;
- Wood Low-E^2 windows (U-Factor = 0.39, SHGC = 0.40) and Velux skylights (U-Factor = 0.41, SHGC = 0.30).
- House wrap
- Tankless gas water heaters with an Energy Factor = 0.80 and full pipe insulation.
- Condensing forced air furnaces with an AFUE = 92.7%, R-8 duct insulation
- HERS-verified Duct Sealing, reduced Building Leakage and Quality Insulation.

Not included as energy credits in the Excellent Performance House are the following measures, some of which are frequently used in large new custom homes:

- Overhangs and sidefins associated with vertical glazing.
- Thermal mass credit for exposed concrete or masonry greater than 1" in thickness -- common with radiant floor hydronic heating.
- Zonal controls which provide different thermostatic controls between Living and Sleeping areas – common with radiant floor hydronic heating.
- High efficiency air conditioners (EER > 10) and/or credit for evaporative cooling;
- Other HERS measures such as TXV, adequate air flow, maximum cooling efficiency, buried ducts and high-efficiency fans.
- Solar thermal collectors for domestic hot water.

The incremental energy measures collectively establish a good energy design*, but they do represent the limit to residential building energy efficiency*. The incremental measures are sufficient to meet the Mill Valley energy ordinance (i.e., in Climate Zone 3) up to a house size all the way up to 12,000 square feet. On the other hand, the ordinance also provides for the use of photovoltaic (PV) systems to exceed Title 24 energy performance and meet the local Mill Valley energy efficiency requirement.

Credit for Solar Photovoltaic (PV) Systems In the Proposed Ordinance

To provide another avenue for the building permit applicant to demonstrate the requisite level of overall energy efficiency, the proposed Ordinance offers credit for solar photovoltaic (PV) electricity generation which is installed at the building site. The credit for PV systems is established by a conservative approximation of the likely electric output of a PV installation converted into Time Dependent Valuation [TDV] energy as KBtu/yr-sf.

Note: The ordinance and the special permit form (worksheet) make it clear that the house must meet the 2005 Building Energy Efficiency Standards without PV credit. PV credit is applicable only when exceeding Title 24 to meet the requirements of the local energy ordinance.

The basis for the credit derives from the results of a CEC/RER Inc. study described at length in Home Energy Magazine's January/February 2003 issue (*Just How Big Is a 2kW Photovoltaic System?*). The annual monitoring of 19 PV installations in California shows that a each nominal KW of installed photovoltaic system produces an average of 1151 kWh/year. Including a 20% degradation factor for less-than-optimal installation and maintenance over the life of the system, this translates to annual site energy per nominal 1.0 kW of PV as follows:

1,151 kWh/yr x 0.80 x 3.413 Btu/watt = 3,142.7 kBtu/yr

The next step is to convert site energy into TDV energy. Assuming that PV systems will generate electricity from approximately an hour after sunrise to an hour before sunset, an average TDV value for electricity is calculated from the hourly TDV values incorporated into the residential and nonresidential ACMs, The daily hours included for each month (also incorporates Daylight Savings Time} are as follows:

Month	TDV Hours Included	Total Hours
January	10AM – 4PM	7
February	10AM – 5PM	8
March	9AM – 6PM	10
April	9AM – 7PM	11
May	8AM – 7PM	12
June	8AM – 8PM	13
July	8AM – 8PM	13
August	9AM – 8PM	12
September	10AM – 7PM	10
October	10AM – 6PM	9
November	10AM – 5PM	8
December	10AM – 4PM	7

In Climate Zone 3, which represents all construction in the City, the average TDV energy value for the above hours is 4.237. This value is very close to (and sufficiently accurate) with respect to the value of 4.22 used in the Marin County ordinance upon which this Ordinance was based and approved. Therefore, the annual TDV energy for each nominal 1.0 KW of photovoltaics is calculated as follows:

3,142.7 kBtu/yr x 4.22 = 13,262 TDV kBtu/yr

This value is then divided by the conditioned floor area of the house to calculate the TDV energy in kBtu/sf-yr, the metric used by the residential ACMs in demonstrating compliance with the Title 24 performance standards. For example, a 6,500 square foot house receives a PV credit for each nominal installed 1.0 KW as follows:

$$\frac{13{,}316 \text{ TDV kBtu/yr}}{6{,}500 \text{ sf}} = \textbf{2.04 kBtu/sf-yr}$$

PV credit in the same house for a 4.5 KW system = 4.5 (2.05) = **9.18 kBtu/sf-yr.**

The special permit form completed for projects covered by the local energy ordinance includes this credit as part of the overall compliance calculation.

Cost Effectiveness

The cost effectiveness of the Ordinance is based on the results of an analysis of the prototype home in Climate Zone 3. The study considers incremental energy measures that just meet the local energy ordinance for different size homes and compares them to the equivalent Title 24 homes.

Using the Prototype House design in each instance, appropriate energy measures that just meet the current Title 24 Standards are assumed. Then the energy measures are incrementally increased to just meet the requirements of the Ordinance. The incremental total first cost of all the measures is divided by the incremental annual energy cost saving to establish a Simple Payback for the additional energy features. The study uses a price of $0.18/kWh for electricity and $0.95/therm for natural gas.

Table 4: Summary of Simple Payback of Energy Measures that Meet the Requirements of the Mill Valley Ordinance

House Size (Square Feet)	Incremental First Cost as Compared w/ Title 24 House ($)	Incremental Annual Energy Cost Saving ($)	Simple Payback (Years)
4,000	$600	$37	16.2
5,000	$2870	$135	21.3
6,000	$6,364	$223	28.5
7,000	$8,258	$348	23.7
8,000	$10,352	$438	23.6
9,000	$15,267	$532	28.7
10,000	$17,347	$650	26.7
11,000	$19,467	$732	26.6
12,000	$23,830	$848	28.1

Implementation Plan

The implementation of the Mill Valley energy ordinance should be a simple and seamless modification of the Marin County local ordinance which has encountered no problems since it first took effect in 2003. .

Proposed and Approved Language of the Mill Valley Energy Ordinance

ORDINANCE NO. 1213

AN ORDINANCE OF THE CITY COUNCIL OF THE CITY OF MILL VALLEY AMENDING THE MILL VALLEY MUNICIPAL CODE BY ADDING A NEW CHAPTER 14.44 ADOPTING ENERGY EFFICIENCY STANDARDS FOR SINGLE FAMILY DWELLINGS GREATER THAN 3,500 SQUARE FEET OF CONDITIONED FLOOR AREA

The City Council of the City of Mill Valley does hereby ordain as follows:

SECTION 1: Chapter 14.44 is added to Title 14 of the Mill Valley Municipal Code to read as follows:

CHAPTER 14.44 ENERGY EFFICIENCY STANDARDS FOR SINGLE FAMILY DWELLINGS GREATER THAN 3,500 SQUARE FEET OF CONDITIONED FLOOR AREA.

14.44.010 Title. This Chapter shall be known as the Energy Efficiency Ordinance.

14.44.020 Background. All single family dwellings must meet or exceed the energy requirements contained in the 2005 California Building Energy Efficiency Standards, including California Code of Regulations, Title 24, Parts 1 and 6. (The "Standards") This ordinance requires the application of the Standards, including but not limited to the definitions, procedures, forms, manuals and alternative calculation methods ("ACM's") associated with the Standards. In addition, this ordinance amends the Standards as described herein.

14.44.030 Buildings Covered.

The provisions of this ordinance shall apply to all single family dwellings for which a building permit has not been applied for and accepted as complete by the Building Department prior to January 1, 2006, or received Design Review approval prior to January 1, 2006, that are

A. New single family dwellings greater than 3,500 square feet of total conditioned floor area. In addition, a residential second unit of not greater than 750 square feet shall be exempt from the requirements of this ordinance.

B. Additions to single family dwellings where the conditioned floor area of the existing building plus the addition is greater than 3,500 square feet and the addition is equal to or greater than 500 square feet, excluding up to a 750 square foot residential second unit.

14.44.040 Definitions.

For the purposes of this Chapter the following definitions shall apply:

A. "PV Credit" is the energy credit applicable to the Proposed Design for a solar photovoltaic system that is capable of generating electricity from sunlight and supplying it directly to the building; and is connected, through a reversible meter, to the utility grid. The amount of PV credit under this Ordinance is defined as W_o multiplied by 13.262 KBtu/sf-yr TDV energy, where W_o is a unitless value calculated as 1000 multiplied by the nominal kilowatts of the proposed PV system and divided by the total conditioned floor area of the building.

B. "Alternative Proposed Design Credit" is an energy credit applicable to the Proposed Design including but not limited to any renewable energy system which is not a solar photovoltaic system and any energy-efficiency measures not included in the Title 24 performance analysis which significantly exceed current building practice or applicable minimum state or federal efficiency standards. The permit applicant must submit calculations to document, explain and justify the amount of the credit claimed subject to approval by the Building Official.

C. "Revised Standard Design Total" is the performance energy budget, in KBtu/sf-yr, which this Ordinance establishes for all buildings to which it applies. It is defined as the Standard Design

Total (TDV KBtu/sf-yr) obtained from any state-approved residential alternative calculation method (ACM) multiplied times the Standard Design Adjustment Factor (contained in Table A).

D. "Standard Design Adjustment Factor" is the arithmetic factor listed below which when multiplied by the standard design energy budget (from a state-approved residential ACM) produces the Revised Standard Design Total.)

Table A: Standard Design Adjustment Factors

House Size (Total Conditioned Sq.Ft.)	Climate Zone 3 Adjustment Factor
3,501 – 4,499	0.930
4,500 – 5,499	0.850
5,500 – 6,499	0.732
6,500 – 7,499	0.663
7,500 – 8,499	0.607
8,500 – 9,499	0.561
9,500 – 10,499	0.521
10,500 – 11,499	0.487
11,500+	0.458

14.44.050 Performance Compliance Approach

Basic Requirements. New single family dwellings with a total conditioned floor area equal to or greater than 3,500 square feet shall meet both of the following:

A.. The Revised Standard Design Total energy budget, in source Kbtu/sf-yr, using the performance compliance approach.

B. All other provisions applicable to low rise residential buildings contained in the California Building Energy Efficiency Standards.

14.44.040 Additions Additions covered by this ordinance as defined in subsection 14.44.030(B) shall meet the requirements of this section by one of the following:

A. The addition shall comply with section 14.44.050.

B. The energy efficiency of the existing building shall be improved so that the existing building plus the addition meet the energy budget in section 14.44.050(A) as applied to the Standard Design Total for the Existing-plus-Addition generated by a state approved Alternative Calculation Method (ACM).

14.44.040 Special Permit Form. In addition to the standard Title 24 report submitted to the building department, a special form will be required which shall be available at the building department.

SECTION 2: Findings Pursuant to Public Resources Code section 25402.2 and Health and Safety Code sections 17958.5, 17958.7 and 18941.5.

To the extent the requirements of this ordinance are deemed to constitute changes or modifications to the requirements of the California Building Standards Code and the other regulations adopted pursuant to Health and Safety Code section 17922, this City Council expressly finds that the provisions of this ordinance are reasonably necessary because of local climatic, geological, or topographical conditions as follows. The City of Mill Valley is in Title 24 climate zone 3 and has many microclimates. During periods when artic masses dominate the weather, nighttime lows drop into the high twenties with daytime highs in the thirties. In climate zone three, (Coastal and certain bay areas), fog is a consistent weather pattern that creates a demand for heating even during summer months.

The Average Maximum temperature is over 80°F for the months of June, July, August and September, and during the summer it is not uncommon for temperatures to reach 100°F in some parts of Mill Valley.

The average house size in the City is getting larger and using more energy. During the 1970s most home construction was approximately 1,500-2,500 square feet. In the years 1998 through 2001 average house size construction continued to rise to approximately 3,000 - 4,000 square feet. These large houses are using more energy and resources.

Due to local climatic conditions and increasing house size, total residential energy consumption within the County of Marin increased from 619 million kWh to 734 million kWh from 1995 to 2000. This 18.5% increase in energy use raises the per capita contribution of costly uncertain energy supplies, pollution, and global warming. Due to local climatic conditions, it is reasonably necessary to enhance the State of California energy code requirements for homes over 3,500 square feet.

SECTION 3. SEVERABILITY

If any article, section, subsection, subdivision, paragraph, sentence, clause, phrase, or word of this ordinance is for any reason held to be unconstitutional or invalid by a court of competent jurisdiction, such decision shall not affect the validity of the remaining portions of this ordinance or any part thereof. The City Council of the City of Mill Valley hereby declares that it would have adopted each article, section, and sentence thereof, irrespective of the fact that any one or more of said provision be declared unconstitutional or invalid.

SECTION 4. EFFECTIVE DATE. This ordinance shall take effect thirty days after adoption, or when the ordinance is approved by the California Energy Commission, whichever is later. This ordinance shall be published once within fifteen (15) days after adoption in the Mill Valley Herald, a newspaper of general circulation in the City of Mill Valley.

THE FOREGOING ORDINANCE was first read at a regular meeting of the Mill Valley City Council on the 21st day of November 2005, and was adopted at a regular meeting of the Mill Valley City Council on the 5th day of December, 2005 by the following vote:

AYES: Councilmembers Raker, Solem, Swanson, Waldeck, Mayor Fisco.
NOES: None.
ABSENT: None.

s/Dennis P. Fisco
Mayor

Attest:
S/Mary H. Herr
City Clerk

Mill Valley Single Family Dwelling Energy Efficiency Form

This form and worksheet, along with all required Title 24 documentation, must be completed and submitted to the Building Department with the building permit application and they MUST be included in the Architectural Plans with the Title 24 CF-1R. This form and worksheet must also be posted at the building site and easily visible at the time of Final Inspection.

Project Name: _____ Date of Title 24 Report: _____

Project Address: _____ Total Conditioned Floor Area: _____

_____ Climate Zone (2 or 3): _____

PV system size in KW: _____ (if applicable)

Compliance Formula

Please use the **Worksheet** on the next page to calculate the following Totals:

1) Adjusted Standard Design Total (KBtu/sf-yr)

_____

From **Calculation #1** on **Worksheet**

MUST BE

> OR =

2) Adjusted Proposed Design Total (KBtu/sf-yr):

_____

From **Calculation #3** on **Worksheet**

As Designed Certification: (MUST be signed at time of building permit application submittal.)

Title 24 Report Author:

I certify that the Title 24 report completed for this project accurately corresponds to the drawings and specifications dated _____ as submitted to the City of Mill Valley with the building permit application.

Name (print): _____ Signature: _____

Company: _____ Professional License #: _____

Telephone #: _____ Date: _____

As Built Certification: (MUST be signed prior to final inspection.)

Circle One: **General Contractor / Owner Builder / Licensed Architect**

I certify that the above energy measures have been properly installed according to the requirements of the Title 24 Certificate of Compliance (CF-1R), the Mandatory Measures (MF-1R), and the City of Mill Valley approved plans.

Name (print): _____ Signature: _____

Company: _____ Professional License #: _____

Telephone #: _____ Date: _____

Staff Use Only: Reviewed by: _____ Building Permit #: _____

Date: _____

Worksheet

***Note: This worksheet MUST accompany the form on the previous page.**

In general, the overall energy efficiency of the house must increasingly go beyond Title 24 requirements as the house size increases from 3,500 sf to over 11,500 sf. Based on the total conditioned floor area of the house, the building must exceed the Title 24 energy budget by the amount specified in the Standard Design Adjustment Factor table (Table A.) using any combination of the following credits:

1. Any building or appliance energy efficiency measures that receive credit within the Title 24 energy code; and/or
2. A solar photovoltaic system defined in the Ordinance under "PV CREDIT"; and/or,
3. Renewable and other energy credits defined in the Ordinance under "ALTERNATIVE PROPOSED DESIGN CREDIT"

Calculations

#1 Calculation of Mill Valley Energy Ordinance Adjusted Standard Design:

Standard Design Total (KBtu/sf-yr):		Climate Zone Adjustment Factor:		Adjusted Standard Design Total: (KBtu/sf-yr)
_____	**X**	_____	**=**	_____
From CF-1R		From Table A.		Use in Compliance Formula

#2 Calculation of Credit for Solar Photovoltaic (PV) Systems in the Proposed Design:

Nominal KW of PV System		Total Conditioned Floor Area (sq. ft.)		Proposed Design Credit (KBtu/sf-yr)
_____	**X 13,316) /**	_____	**=**	_____
From PV Manufacturer		From CF-1R		Use in # 3

#3 Calculation of Adjusted Proposed Design Total

Proposed Design Total (KBtu/sf-yr)		Proposed Design Credit (KBtu/sf-yr)		Adjusted Proposed Design Total: (KBtu/sf-yr)
_____	**-**	_____	**=**	_____
From CF-1R		From # 2		Use in Compliance Formula

Note: The Proposed Design Total (KBtu/sf-yr) must be equal to or less than the Standard Design Total as shown on the CF-1R form submitted in the Title 24 report.

Table A. Standard Design Adjustment Factor

House Size (Conditioned Sq.Ft.)	Adjustment Factor
3,501 – 4,499	***0.930***
4,500 – 5,499	***0.850***
5,500 – 6,499	***0.732***
6,500 – 7,499	***0.663***
7,500 – 8,499	***0.607***
8,500 – 9,499	***0.561***
9,500 – 10,499	***0.521***
10,500 – 11,499	***0.487***
11,500+	***0.458***

Appendix A: Cost-Effectiveness Data

2005 Mill Valley Study: Annual Energy Savings

House (sf)	Site Electricity Saving (KWh/yr)	Site Gas Saving (therms/yr)	Electricity Cost Saving ($)	Nat. Gas Cost Saving ($)	**Total Annual Cost Saving ($)**
4000	-142	66	-$26	$63	**$37**
5000	16	139	$3	$132	**$135**
6000	939	57	$169	$54	**$223**
7000	1096	159	$197	$151	**$348**
8000	1247	225	$224	$214	**$438**
9000	1417	292	$255	$277	**$532**
10000	1649	372	$297	$353	**$650**
11000	1820	426	$328	$405	**$732**
12000	2060	502	$371	$477	**$848**

$/thrm = $0.950 **$/kwh = $0.180**

House (sf)	**Installed Cost All Measures**	**Simple Payback (Years)**
4000	$600	16.2
5000	$2,870	21.3
6000	$6,364	28.5
7000	$8,258	23.7
8000	$10,352	23.6
9000	$15,267	28.7
10000	$17,347	26.7
11000	$19,467	26.6
12000	$23,830	28.1

2005 Cost Summary for Mill Valley House **12/28/05**

Insulation --

House Size (sf)	Roof Area (sf)	Net Wall Area (sf)	Floor Area (sf)	(inc. Rad.B) Incremental Roof Cost (/sf)	Incremental Wall Cost (/sf)	Incremental Floor Cost (/sf)	Total Incremental Insul & Framing Cost ($)
4,000	2400	2462	2400	$0.00	$0.00	$0.00	$0
5,000	3000	2636	3000	$0.00	$0.00	$0.24	$720
6,000	3600	2772	3600	$0.00	$0.00	$0.24	$864
7,000	4200	2878	4200	$0.00	$0.00	$0.24	$1,008
8,000	4800	2966	4800	$0.00	$0.00	$0.24	$1,152
9,000	5400	3030	5400	$0.00	$0.70	$0.24	$3,417
10,000	6000	3082	6000	$0.00	$0.70	$0.24	$3,597
11,000	6600	3118	6600	$0.00	$0.70	$0.24	$3,767
12,000	7200	3146	7200	$0.00	$0.70	$0.24	$3,930

HVAC & Water Heater System

House Size (sf)	DHW Syst.	Furnaces	Tight Duct	House Wrap	R-6/8 Ducts	Quality Insul.	Low-E2 Windows
4,000	$200	$0	$0	$0	$400	$0	$0
5,000	$1,750	$0	$0	$0	$400	$0	$0
6,000	$1,800	$0	$0	$0	$400	$0	$3,300
7,000	$3,000	$0	$0	$0	$400	$0	$3,850
8,000	$3,000	$1,400	$0	$0	$400	$0	$4,400
9,000	$3,000	$1,700	$0	$1,500	$700	$0	$4,950
10,000	$3,000	$1,700	$1,200	$1,650	$700	$0	$5,500
11,000	$3,550	$1,700	$1,200	$1,800	$700	$0	$6,050
12,000	$3,600	$1,700	$1,200	$1,900	$700	$3,500	$6,600

		Grand Total for All Measures ($)
		$600
		$2,870
		$6,364
		$8,258
		$10,352
		$15,267
		$17,347
		$19,467
		$23,830

BldgLeak	Total Incremental HVAC/DHW Cost ($)
	$600
	$2,150
	$5,500
	$7,250
	$9,200
	$11,850
	$13,750
$700	$15,700
$700	$19,900